

## 3G Services Adoption among University Students: Diffusion of Innovation Theory

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### Abstract

*3G services represents an evolution in telecommunication industry. However, 3G services has not received great adoption rate as expected despite of various benefits provided by this service. This study aims to investigate the factors affecting the intention to adopt 3G services among the university students in Malaysia since they expected to be the group with great potential to adopt 3G services. Diffusion of innovation theory is modified and applied in this study to achieve the objective. Results of this study show that perceived compatibility, perceived relative advantage, perceived results demonstrability, perceived trailability, perceived image, and perceived enjoyment are significantly associated with intention to adopt 3G services. Surprisingly, perceived cost of using 3G services is found to be positive but insignificant associated with intention to adopt 3G services. Managerial implications and conclusion have been discussed.*

Keywords: 3G Services Adoption, Diffusion of Innovation Theory, University Students

### 1. Introduction

The development of science and technology is never stagnant. They evolve and continuously grow from day to day. Technology today will soon be the past tense and subsequently updated and replaced with more advanced and refined technology. Along with the development, mobile technology, the technology embedded in a small communication device, is getting more and more sophisticated.

Mobile technology can be traced to its 0G history, in which it is the first mobile communication service right after the World War II. The evolution then happened with the advancement in 1G, 2G, 2.5G, 3G, and 4G. The main distinction among the various phases of development is the technology quality. Record shows that 1G mobile cellular employed analogue technology while 2G used digital technology. While, 3G combines high-speed mobile access with Internet Protocol (IP) and it is proven with faster communication service and higher capacity processing record. The International Telecommunication Union (ITU) states that 3G must be capable of a minimum speed of 144K bits per second. Indeed, the invention of 3G technology

offers a bundle of services and conveniences, including increased voice capacity, video conferencing and internet browsing capability. In short, it offers higher-speed data rates to the users.

The study on the wireless mobile technology, 3G technology in particular, is voluminous. 3G is expected to have a significant impact on the cell phone market. The benefits of the technology seem have bombarded the media headlines. Some advantages include the cell phone utility expansion, it allows field workers to contact and get information instantly [19], it enables consumers and businesses to build rapport [17], and 3G provides high-speed e-mail and Internet access [14]. Recognising the importance and benefits of 3G services, Malaysian Communications and Multimedia Commission [11] has recently published a statistic about the survey of hand phone users in Malaysia. The findings of the survey are supportive and informative, pointing out the current trend and the mobile technology adoption behaviours of the Malaysian mobile phone users. The statistics reveals that public awareness of 3G technology increased from 52.80 percent in 2005 to 65.70 percent in 2006. Nonetheless, the keenness of changing to 3G telephony dropped slightly to 28.10 percent in 2006, compared to 30.10 percent in 2005. Thus, the low market penetration in Malaysia of 3G technology adoption is questionable albeit high awareness of the 3G platform.

Additionally, the benefits and advantages of using 3G services are well documented and reported [e.g. 17]. Somehow, the 3G acceptance and adoption from among the mobile phone users are still very low. As indicated in the publication of MCMC [11], only 1.60 percent of the total subscription base has subscribed 3G service. The one digit subscription rate clearly speaks for its low usage. According to the report of MyICM [15], there were 300, 000 subscribers of 3G in Malaysia in 2006. The authorised body has planned to increase the subscription number to 1.5 million in the mid of 2008 and at least 5 million in 2010 [15]. In fact, only 6 percent of British claimed themselves possess 3G handset although the country is identified as the world's highest 3G adoption country [10]. Ironically, this has not stopped the telecommunication operators from pouring extensive capital into developing and launching the 3G applications. In Malaysia, two of the three major

mobile telecommunication service providers have successfully launched the 3G services while another is expected to launch by the end of 2008. In view of the future prospect of 3G services and the enthusiasm of the industry in this service, it is thus interesting to investigate the underlying reasons of the low 3G service penetration in Malaysia. Following that, 3G technology adoption model will be developed to provide future direction.

In short, little attention has been directed to find out the 3G technology acceptance among the cellular phone user. To the best knowledge of the authors, no published study has been so far carried out in Malaysia regarding the 3G technology adoption except the preliminary work completed by MCMC [11]. As such, the topic on 3G mobile technology deserves detailed examination in Malaysia context. As an exploratory study in Malaysia, this study is focusing on the university students in the country rather than the population as a whole. This approach is justifiable on the ground that most university students in the country have mobile phones and this group of people are highly educated and hence have greater exposure to the technology development. Supported by the low 3G awareness in Malaysia [11], university students are selected to avoid biasness if other group of respondents whom with no 3G awareness are included in the study

The study will mostly help the mobile service provider in understanding the technology adoption pattern from the perception of the consumers. Therefore, they are more responsive to various kinds of needs and can better utilise the information to cater to the demands.

## 2. Review of Literature

### 2.1 Diffusion of Innovation Theory

Since 1962, Rogers [18] has synthesised more than 3800 innovation diffusion literatures and formalised the theory of Diffusion of Innovation. Diffusion of Innovation (DOI) research attempts to explain the process by which an innovation is communicated through certain channels over time among the members of a social system. There are five steps in the success or failure of innovation adoption over time, i.e. knowledge, persuasion, decision, implementation and confirmation. The persuasion step is the most crucial step in determining whether an innovation is successfully accepted or declined. In this step, the perceived characteristics of the innovation play an important role in influencing potential adopters' decision to adopt or not to adopt the innovation. Rogers [18] has incorporated five innovation characteristics as the antecedents to any adoption decision, namely

relative advantage, compatibility, complexity, trialability and observability. The importance of understanding the characteristics of innovation is evidenced in the fact that perceived characteristics of an innovation explain 49 percent to 87 percent of the variance in the rate of adoption [18]. Higa, Sheng, Hu and Au [9] have indicated that a large stream of literatures studying innovation diffusion focuses on the characteristics or attributes of innovation, and empirically proved that innovation characteristics are able to explain the adoption of technological innovation and hence, it is important to understand the characteristics of an innovation in diffusion research.

### 2.2 Perceived Characteristics of Innovating

In the following years, Moore and Benbasat [13] have expanded Rogers' [18] perceived innovation characteristics to form the Perceived Characteristics of Innovating (PCI). Moore and Benbasat [13] have included three original characteristics into PCI, i.e. relative advantage, compatibility, and trialability. In order to be consistent with other established technology acceptance models [e.g. 3], Moore and Benbasat [13] have renamed complexity as ease of use. In addition to this, Moore and Benbasat [13] have argued that Rogers [18] observability characteristics are actually composed of two sub-characteristics, i.e. result demonstrability and visibility. Image is thought of as an independent characteristic in Rogers [18] original relative advantage characteristics and hence, is added in PCI. Finally, Moore and Benbasat [13] have indicated that voluntariness influences individual's decision to adopt or reject an innovation.

Some researchers found inconsistent findings from one study to another study using the original DOI model. Perhaps, Moore and Benbasat [13] have identified the possible cause of inconsistent results put forward by Rogers [18] DOI model. Moore and Benbasat [13] have argued that Rogers' diffusion of innovation theory studied the primary attribute of an innovation instead of the perceived characteristics of the innovation by the potential adopters. Primary attribute is intrinsic to an innovation and is independent from the perception of potential adopters. Because different potential adopters have different perceptions on the primary attributes of an innovation, studying perceived attributes (secondary attribute) yields more accurate results [13]. Based on this argument, Moore and Benbasat [13] developed PCI that is specifically tailored to study the potential and current users' perception of using an innovation. All together, PCI is an expanded and refined version of Rogers original perceived innovation characteristics with eight characteristics.

### **2.3 Theory of Reasoned Action**

In information system literature, researchers developed many models to explain the acceptance of technology among potential users. The Theory of Reasoned Action (TRA) is one the very first models that is widely cited to explain the acceptance of technology. Drawing from social psychology, the Theory of Reasoned Action is one of the most fundamental and influential theories of human behaviour [23]. TRA deals with the determinants of an individual's behavioural intention, in which the behavioural intention will affect actual behaviour [1; 6]. According to TRA, a person's behavioural intention (a measure of strength of one's intention to perform a specified behaviour) is jointly determined by the person's attitude (an individual's positive or negative feelings about performing target behaviour) towards the behaviour and subjective norm (the person's perception that most people who are important to him think he should or should not perform the behaviour in question) [6]. Furthermore, a person's attitude is determined by the person's belief (the individual's subjective beliefs regarding the consequences of performing the target behaviour) and evaluation (implicit evaluation of the consequence) [6]. Likewise, an individual's subjective norm is determined by normative beliefs (perceived expectations of specific referent individuals or groups) together with motivation to comply with the expectations [6].

TRA has been proven empirically to predict human behaviours across many settings [1]. TRA, however, is argued as a general model predicting individual's behavioural action, without specific beliefs on a particular behaviour [4]. Specifically, TRA serves as a mediator between target specific beliefs and actual behaviour towards the target behaviour [4]). Target specific beliefs are posited as external variables by Fishbein and Ajzen [6].

### **2.4 Technology Acceptance Model**

Addressing the weakness of TRA, Davis [3] has introduced the Technology Acceptance Model (TAM). TAM is an adaptation of TRA specifically tailored for modelling user acceptance of information systems [4]. The main objective of TAM is to explain individual computing technology acceptance using a parsimony and theoretical justified model [3]. TAM is one of the most widely applied technology adoption models in the information system literature mainly due to its parsimonious, i.e. economical to apply, in research settings. The goal of this model is individual's behavioural intention to adopt a technology, which

will predict actual technology use. The definition of behavioural intention in TAM is the same as the one in TRA. The difference in TAM compared to TRA is the exclusion of Subjective Norm. According to Davis [3], Subjective Norm is one of the least understood aspects in TRA, partly due to measurement problems [25] and theory conceptualisation problem [16]. Since TAM is developed with computer technology acceptance in mind, Davis [3] has posited that perceived usefulness (the degree to which a person believes that using a particular system would enhance his or her job performance) and perceived ease of use (the degree to which a person believes that using a particular system would be free of effort) jointly determine an individual's attitude towards using a technology. Attitude is adapted from TRA. Perceived usefulness, on the other hand, is postulated to be influenced by perceived ease of use and perceived usefulness itself is a direct determinant of individual's behavioural intention.

### **2.5 Perceived Cost**

In the Malaysian hand phone survey conducted by MCMC [11], the main reasons for respondents not wanting to migrate to 3G services are "the phone is too expensive" and "the service is too expensive". These reasons appear to be as "perceived cost" factor of using 3G services. Perceived cost is the evaluation of the benefit of the service in comparison with the cost of using the service [2]. When users perceive that the cost is greater than the benefits a service can bring, users will be reluctant to subscribe to that service. In general, cost plays an important role in determining the adoption of technology among potential users. The Model of Adoption of Technology in Households (MATH) identified a number of factors predicting technology adoption in the households which includes the control belief construct. One of the concepts in control belief is the perceived cost in adopting a technology [22].

### **2.6 Perceived Enjoyment**

Davis, Bagozzi, and Warshaw [5] have modelled the role of intrinsic motivation in TAM by introducing the concept of perceived enjoyment. Perceived enjoyment is defined as "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated". In addition to this, perceived enjoyment is theorised to influence usage intention directly [5]. Intrinsic motivation evaluates an individual's liking, enjoyment, joy and pleasure associated with technology use [23]. In fact, a similar concept was proposed by Triandis [21]

before Davis's work in which affect (i.e. the feeling of joy, elation, pleasure, disgust, and displeasure) may affect behaviour. Empirical studies that support the influence of perceived enjoyment on behavioural intention to use include Internet usage [20] and Websites usage [8].

### 3. Research Model and Hypotheses

Following the nomological model of TRA and TAM, the dependent variable for this research is consumers' behavioural intention towards using 3G mobile services. Independent variables consist of the variables identified to affect 3G mobile service adoption among university students in Malaysia.

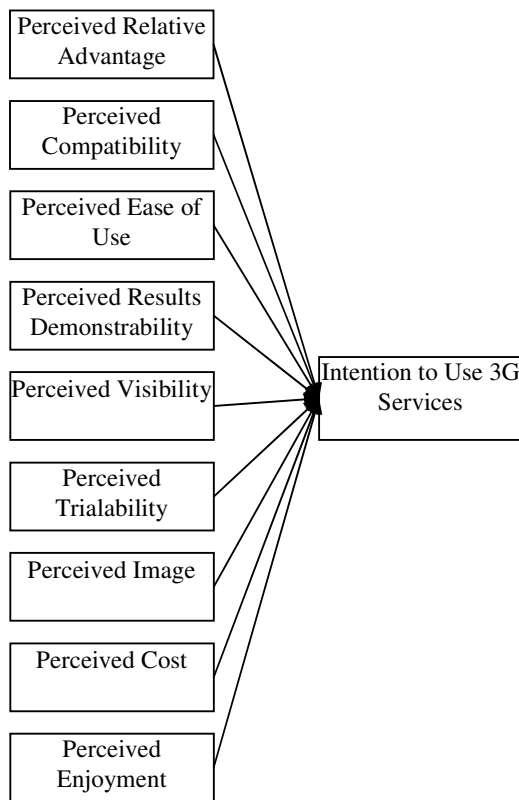


Figure 1: Research Framework

#### 3.1 Hypotheses

Based on Moore and Benbasat [13] PCI, the authors propose that users would gain better benefits using 3G mobile services for the sake of enhancing their mobile lifestyle. It is then assumed that the perception will lead to higher intentions to use 3G mobile services among consumers. In view of this, the following hypothesis is constructed.

*H1: Perceived relative advantage is positively related to 3G mobile services use intention.*

The perception that an innovation is compatible to the beliefs, experiences and needs of potential adopters are important to increase the adoption rate of the innovation [18]. Perceived compatibility is related to the potential adopters' familiarity towards the innovation. An innovation that is designed with great departure from existing beliefs and experiences will have difficulties in gaining acceptance by the target adopters. Consequently, it is proposed that

*H2: Perceived compatibility is positively related to 3G mobile services use intention.*

An innovation that is simple to use and does not require steep learning curve will increase adoption [3; R18]. Thus, this study proposes that:

*H3: Perceived ease of use is positively related to 3G mobile services use intention.*

In PCI instrument development process, perceived result demonstrability is a better concept for capturing user's perception on innovation's tangible results of using the innovation [13]. This includes whether the innovation can demonstrate any potential benefits. The more communicable an innovation is, the more likely the innovation will be adopted [27]. Hence, the following hypothesis is formed.

*H4: Perceived result demonstrability is positively to 3G mobile services use intention.*

Rogers [18] has indicated that the more exposure of an innovation, the more likely it is to be adopted by potential users. In other words, if an innovation is easily seen by potential users, it would have higher chances to be adopted. Hence, if users perceive that the use of 3G mobile services can be observed easily, they would have higher intention to use it.

*H5: Perceived visibility is positively related to 3G mobile services use intention.*

An innovation that can be tried on a limited basis before it is fully employed will gain faster acceptance rate[18]. This is because adopters are able to examine the level of uncertainty induced by using the innovation. In addition to this, trialability is able to offer learning opportunity for potential adopters in a lower cost [18]. Trialability is theorised to affect user's behavioural intention. Wungwanitchakorn [26] has found support for trialability influence on bank customers' intention to use Internet banking. Mahmood et. al. [12] empirical research supports the hypothesis that trialability influence e-learning adoption. Based on the literatures, the authors posit that,

*H6: Perceived trialability is positively related to 3G mobile services use intention.*

Image refers to the perception of an individual with regard to their position in their social structure when

they adopt an innovation [13]. In the context of this study, image implies that the more an individual use 3G mobile services, the higher social status he/she gains. Hence,

*H7: Perceived image is positively related to 3G mobile services use intention.*

As discussed in the previous section, the perception of cost on using an innovation will affect the rate of adoption. If a student perceives that using 3G mobile services requires higher cost commitment than he/she affords, this will reduce his/her intention to use 3G mobile services.

*H8: Perceived cost is negatively related to 3G mobile services use intention.*

Intrinsic motivation on using an innovation will lead to positive use intention [5]. Besides making video call, 3G mobile services also enable an individual to play online games with other mobile users. This is possible because of the higher network bandwidth offer by 3G mobile operators. There is more enjoyment that can be delivered by 3G mobile services other than playing games. When a student perceives that using 3G mobile services are fun and pleasure, this will increase the likelihood of 3G mobile service acceptance and hence,

*H9: Perceived enjoyment is positively related to 3G mobile services use intention.*

#### 4. Research Design

The instrument used in this study is mainly adapted from Moore and Benbasat [13] with some amendments made to suit the context of this study. The concept for perceived cost is added into the model in view of the report by MCMC [11] indicating that cost of the mobile phone with 3G features and high service charge for using 3G services are the major reasons for low 3G services usage in Malaysia. The instrument for this variable is self-developed and has been sent for expert review for face validation.

In order to testify the theoretical framework of diffusion of innovation theory in the context of adoption of 3G services among university students, 251 set of primary responses were collected between March 2008 and April 2008. Quota sampling method is used to select the respondents based on the stream of their study. The questionnaires are distributed to students from both Art and Science stream through the academics in respective faculty. This is to ensure that the two main groups of students have are taken into consideration in this study. The data collected are then analysed with SPSS. The internal consistency of the items within each of the variables are analysed using Cronbach's Alpha. Since all the independent variables and dependent variable are

measured by Likert scale, which is an ordinary-interval hybrid scale that enable the performance of parametric data analysis [7], Pearson correlation is used to test the significance of association.

#### 5. Results and Data Interpretations

Table 1 shows the background of the respondents in term of their stream of study, duration of using mobile phone, and the availability of 3G supporting features in their mobile phone. From the table, 62.2 percent of the respondents are from the Art stream, while the remaining is from the Science stream. Almost half of them (49.8 %) have used mobile phone for 1-5 years with another 49.8 percent of the respondents identified themselves of having used mobile phone for at least 6 years. Therefore, this indicates that the respondents are familiar with the mobile technology. In addition, 39.8 percent of them have mobile phones that support 3G services. Although this percentage is less than half, this figure is promising since it is higher than the average of the nation. Moreover, there are only 6 percent of British own a mobile phone that equipped with 3G features [10]. Thus, the result supports the approach used in this study that focuses university students only given that they are the group with highest potential to adopt 3G services.

Table 1: Frequency Analysis of the Respondents' background

Variable	Category	Frequency	Percent
Stream of Study	Art	156	62.2
	Science	95	37.8
Duration of using mobile phone (year)	Less than 1 year	1	0.4
	1 to 5 years	123	49.8
	6 to 10 years	106	42.9
	11 to 15 years	11	4.5
	More than 15 years	6	2.4
Availability of 3G feature in mobile phone	Yes	100	39.8
	No	151	60.2

Analysis of internal consistency shows that all variables examined in the study have Cronbach's Alpha value ranging from 0.833 to 0.955. These results show the evidence regarding high reliability of the concepts used in the present research. The results of the associations between independent variables and dependent variable are tabulated in Table 2. The Pearson correlation results show that, perceived compatibility ( $r=0.344$ ;  $p<0.05$ ), perceived relative advantage ( $r=0.320$ ;  $p<0.05$ ), perceived image ( $r=0.323$ ;  $p<0.05$ ), perceived results demonstrability ( $r=0.162$ ;  $p<0.05$ ), perceived

trialability ( $r=0.322$ ;  $p<0.05$ ), and perceived enjoyment ( $r=0.314$ ;  $p<0.05$ ) are found to have positive and significant association with intention to use 3G services. The existence of these elements will significantly induce the student's intention to adopt 3G services. Among them, perceived compatibility is found to have the highest correlation coefficient with behavioural intention to use 3G services.

On the other hand, perceived ease of use ( $r=0.096$ ;  $p>0.05$ ), perceived visibility ( $r=0.090$ ;  $p>0.05$ ), and perceived cost ( $r=0.024$ ;  $p>0.05$ ) are found to have positive association with intention to use 3G services but the associations are not statistically significant. This indicates the tendency of higher perceived cost of using 3G services, higher will be the intention to use the service. However, this relationship is not statistically significance.

Table 2: Pearson Correlation between Diffusion of Innovation Characteristics and intention to adopt 3G services

Variables	Behavioural Intention	
	r	Sig.
Compatibility	0.344**	0.000
Ease of Use	0.096	0.132
Relative Advantage	0.320**	0.000
Image	0.323**	0.000
Results Demonstrability	0.162*	0.011
Trialability	0.332**	0.000
Visibility	0.090	0.161
Enjoyment	0.314**	0.000
Cost	0.024	0.709

In line with the theory of innovation diffusion theory, university students' perception on the compatibility of 3G services with their existing life-style, the relative advantage of 3G services, the prestige in using 3G services (image), the ability to demonstrate the impact of using 3G services, the ability to experience the 3G services, and the enjoyment of using 3G services are found to be significantly associated with the intention of the university students to use 3G services.

The results aforementioned demonstrate high consistency with most previous studies. Hence, more emphasis is placed on other variables, which are reported deviate from the expectation. They are the university students' perception on their ability to master the 3G services (ease of use), the visibility of 3G services in their environment, and the cost of using 3G services. Perceived ease of use of 3G services by the university students is not significantly associated with their intention to adopt 3G services. This might be due to the nature of mobile phone with small screen and navigation tool that has turned down the interest to adopt 3G

services [24] even they might feel no problem for them to learn this technology. Besides, small screen size of mobile phone might have made the impact of 3G services less obvious. Furthermore, mobile phone is a more personal equipment if compared with desktop or laptop that shares the similar features such as video-conferencing, surfing online, and watching TV programme. Apart from that, the actual 3G services users in Malaysia are also very limited. This might make perceived visibility of 3G services not an important factor to be considered when comes to the decision to adopt 3G services.

The most surprising finding, however, is the perceived cost of using 3G services, which MCMC [11] has highlighted it as the main reason why Malaysian do not want to use 3G services. It is found not be significantly associated with intention to adopt 3G services in this study. Not only that, perceived cost is found to be positively associated with intention to adopt 3G services on the contrary, in which it indicates that the higher the cost of using 3G services, the greater their willingness to adopt the service, although it is not statistically significant. Few reasons might explain this situation. First, the respondents of this study are made up of university students, who basically rely on either their parents or sponsorship to survive. Thus, they might not treat money as serious as the general population in the country. Reinforced by the positive association between image and intention of 3G services adoption, we can most probably link the money, status, and intention of 3G adoption together. For example, students might feel that higher cost in using 3G services will show off the status and create a unique image.

## 6. Managerial Implications

The result of this study is crucial for the policy makers and mobile network service providers to improve the adoption of 3G services in the country. Since the intention to adopt 3G services is significantly associated with perceived compatibility, perceived relative advantage, perceived image, perceived results demonstrability, perceived trialability, and perceived enjoyment, the promotions for 3G should be in place to enhance these factors.

The policy makers and the 3G network service providers can promote 3G services by highlighting the compatibility of the consumers' current life-style with 3G services, such as they will be able to watch TV programmes, surfing internet, and communicate face-to-face with their family and friends whenever they are. The promotion needs to emphasize that 3G services adoption is perfectly fit their life style. In fact, the adoption will improve the way they live currently as location will no

longer be a limitation for them to do what they intend to do. This shows the relative advantage of using 3G services compared to using other devices like computers. Besides, more road shows should be arranged to let the consumers to try out 3G services. In addition, the promotion campaigns of 3G services should also highlight the enjoyment and demonstrate the prestige of using 3G, especially among the youngsters. Testimonial from those who have adopted 3G services could be a very powerful tool in promoting the 3G services as well.

## 7. Conclusion

The results hinted that diffusion of innovation theory might be incomprehensive to analyse the adoption of 3G services among the university students in Malaysia. Only six out of nine independent variables are significantly associated with intention of the students to adopt 3G services. In addition, the correlation coefficient of all significant variables is considered weak [7] even though they are statistically significant. This study would recommend that future researchers need to use more variables to study the adoption of 3G services. However, this study can still provide some ground breaking initiative to study the factors for 3G services adoption in Malaysia. However, the readers of this research paper should be aware that the respondents of this study are drawn from university students. Thus the results cannot be generalised to the whole population in Malaysia.

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